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(proof version)

St Praxedis trice; Technical Examinations of St Praxedis

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St Praxedis, 1,2,3,4.

The early works of Johannes Vermeer have presented the scholarly community with difficult problems. They are distinctly different in concept and execution from Vermeer's mature style. This has led to diverse opinions and heated discussions on the dating and attribution of Vermeer's early works.[2] These discussions intensified after A.K. Wheelock, curator of Northern Baroque Paintings of the National Gallery Washington, followed an earlier suggestion by M. Kitson that a painting of St Praxedis, then in the Barbara Piasecka Johnson collection, would be an autograph early painting by Vermeer.[3] (fig. 1) The St Praxedis is thought to be a replica, or a faithful copy, after a painting by Felice Ficherelli (1605-1669), now in the Fergnani Collection, Ferrara. (fig 2) In both, almost identical paintings St Praxedis is depicted in a stunningly-powerful, deep raspberry-red dress, kneeling directly before the viewer. Surrounded by large classical buildings, she squeezes blood from a sponge into a decorated silver ewer. A second figure, possibly a St Pudentia, is in the right background.

The attribution of *St Praxedis* to Vermeer, is primarily based on the date and signature at the lower left: "Meer 1655"(1653?) and the purported inscription at the bottom right: "Meer N R[..]o[.]o".[4] Other arguments are found in the stylistic and thematic relationships to other early Vermeer paintings.[5] Many scholars adamantly rejected the attribution. Jon Boone wrote in 2002 in the 'Essential Vermeer 2.0', that: "In looking at *Saint Praxedis* one does have a hard time understanding its attribution to Vermeer. It is a second-rate copy of a mediocre painting by an undistinguished artist, with certain features – such as the awkward wrap-around hands –antithetical to Vermeer's sensibility as well as his draftsmanship ".[6] As the *St Praxedis* shows such prominent Italianate features, many scholars assume that the painting is not Dutch at all, but a seventeenth-century Italian painting. And indeed, the *St Praxedis* is 'in theme and conception wholly typical of the Florentine Seicento'.[7]

Given these arguments one should, therefore, first try to establish whether the picture under investigation is of Dutch or Italian origin, and try to understand more about its genesis and technical features. It seems imperative that a technical examination of the copy should be made. This should, of course, be done in close comparison with the *St Praxedis* that seemed to have been the impetus of it all: the one in the Fergnani Collection in Ferrara.[8] (fig 2) All scholars are in agreement that the Kitson *St Praxedis* (see note 7) is a very close copy of the Ferrara *St Praxedis*.

It is, however, not generally known that the Ferrara *St Praxedis* in its turn, is also a very faithful copy. On 17 October 2017 another picture with a saint Praxedis was sold at the auction house Dorotheum in Vienna.[9] In the auction catalogue this painting labelled *St Praxedis*, was also described as painted by Ficherelli (fig 3). This 'new' *St Praxedis* had always been in the Bardi-Serzelli collection in Florence. It was already mentioned as a Ficherelli in Baldinucci's 1681 inventory.[10] It had lived in Florence from the seventeenth century till the twenty-first, remained fairly inaccessible for anyone outside the Serzelli or Bardi families, and never left the country. In that collection it was unavailable for any later copying after it had left the studio of Ficherelli. It is, therefore, not likely to be directly associated with the Kitson *St Praxedis*. It can, however, be directly associated with the Ferrara painting. The Bardi-Serzelli painting has already in 1681 been documented as by Ficherelli. And also the Ferrara picture has always unanimously, and convincingly, been given to Ficherelli. Both pictures stem from the same studio, and somehow must share a common genesis. The Bardi-Serzelli *St Praxedis* appears almost identical to the Ferrara and the Kitson pictures. However, the dimensions of this painting, measuring 115 × 90 cm, are larger than for the other two. And the saint's figure is painted in a fluffy, almost 'soft-focus' brushwork with an opaque orangey red, rather than the translucent raspberry-red lake pigments for the other two.

This provokes questions about the genesis of the whole series.

The very first design for the figure of the saint *Praxedis* of the whole series, was a drawing in black chalk on paper.[11] The

Fig 1 Johannes Vermeer (attr.) *St Praxedis*, oil on canvas, 101.6 x 82.6 cm, National Museum of Western Art, Tokyo, signed and dated 1655. (the Kitson *St Praxedis*)

Fig 2 Felice Ficherelli, *St Praxedis*, oil on canvas, 102.5 x 78.9 cm, c. 1645, Fergnani Collection Ferrara (the Ferrara *St Praxedis*)

drawing originally must have been much more powerful, than it is now. It is now vague, washed out, and water-stained. (fig. 4) In this drawing the saint was placed to the right in in an open landscape with trees and a small classical temple on the background to the left. For the first painting of the series, i.e. the Bardi-Serzelli *St Praxedis*, the figure of the saint was then free-hand copied from the drawing onto the canvas. But on the canvas the figure was more centrally placed in a different architectural setting. Infrared examinations by professor Gianluca Poldi of the university of Bergamo, have shown that during the actual painting process several changes to the initial composition had been made. In the initial underdrawing of the painting, a column with a Tuscan base was planned to the left. This was to replace the small temple in the landscape of the background of the drawing. But in the end, only the figure of the saint with her ewer and the stone plinth in the foreground were used in the painting.[12] In his examination of the painting, Poldi found a number of pentiments that give clear evidence that during the painting process, the painter made a number of alterations to accomplish the final result. In the final version the idea of the column to the left was abandoned

Fig 3 Felice Ficherelli, *St Praxedis*, oil on canvas, 115 x 90cm, c. 1640, private collection, (the Bardi-Serzelli *St Praxedis*)

Fig 4 Felice Ficherelli, *St Praxedis,* drawing in black chalk on paper, 40 x 40 cm, Florence, Galerie degli Uffizi, Gabinetto degli Stampe e Disegni, inv. no. 3705 S (digitally enhanced photograph)

and replaced with a simple square block. To the right, initially, a much more ornate architecture was foreseen.

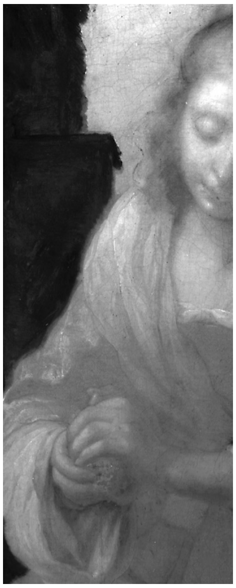
Infrared examinations of the other two paintings do not show any of such pentiments. The other two paintings just faithfully follow the final stage of the Bardi-Serzelli *St Praxedis*. This would strongly suggest that the Bardi-Serzelli *St Praxedis* was the first painting of the series, from which the other two are derivatives. Copying from this first, original painting was done extremely close in proportion and to scale. The dimensions of the Bardi-Serzelli painting may be slightly larger than those of the Ferrara *St Praxedis*, but not by much. The first version just has slightly more background. And it is there that the differences can be found. The classical ruins in the background to the left extend a little bit higher and there is more and cloudier blue sky than on the Ferrara *St Praxedis*. To the right we see more of the Pantheon-like building with the cupola. We see more people gathered at the entrance. And the tympanum above shows a putto holding a blank coat of arms. Otherwise, however, the figures of the beheaded martyrs and the saints Praxedis and possibly Pudentiana, and the ewers in which the blood of the martyrs is spent, are identical in form and size. An overlay of the two paintings sized to scale shows that the figures are virtually congruent! (fig 5) This remarkably precise similarity is the result of a fairly simple standard studio practice.

Fig 5 overlay - scaled to size - of the Ferrara *St Praxedis* in black and white at 50 % transparency over the Bardi-Serzelli *St Praxedis* in colour.

Making copies

Methods for copying paintings have a long history. It is quite telling that the very first recipe in the Byzantine painters' manual by Dionysius describes a method used to make a copy of a respectable example.[13] That method is not essentially different from the procedure that is described in the seventeenth-century treatise *Modo da tener nel Depingere* by the painter Giovanni Batista Volpato.[14] In this Volpato manuscript, the activities in the painter's studio are described in the form of a dialogue between two painter's apprentices. And transferring the outlines of a composition from one painting to the other with the use of tracing paper is described as the humble task of the assistant and not that of the master.[15]

The dialogue relates that transparent paper is prepared to the size of the original painting, laid over it and that the contours of the figures visible through the paper are traced, either with black chalk of with a piece of charcoal. Next, another piece of paper of the same size was dusted with pigment powder, lead white or gypsum. This second piece of paper was then – with the powdered side below – laid over the primed copy canvas. The transparent paper was then laid on top of this, and the contours of the drawing were traced with the pointed back side of a brush. The pressure of the point trans-



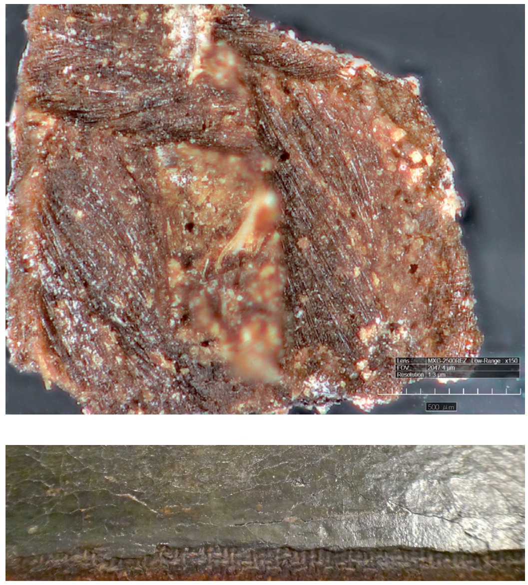


Fig 6 (left) infrared reflectogram (detail) of the Ferrara *St Praxedis*, showing reinforcements with very fine contour lines in carbon black (graphite?)
Fig 7 (right)
a, detail from the open edge of the Ferrara *St Praxedis*, showing it made on a twill-weave canvas,
b twill weave fraction 2/1 as impression of the canvas in the back side of the ground layer (digital microscope, low range mag., 150 x, scale bar = 500 µm)

lated through the papers and resulted in the deposition of the pigment powder, lead white or gypsum, onto the target surface, i.e. the prepared canvas. In this manner, the tracing on the transparent paper was – though sometimes slightly vague – transferred. These transferred lines could then serve as a the underdrawing for the copy. In the infrared reflectogram of the Ferrara *St Praxedis*, it can be seen that those powdery contours were subsequently traced and reinforced with very fine lines in carbon black. These faint lines show most clearly as loose, casual squiggles for the curls of Praxedis's hair, very fine contour lines in and around her white shoulder cloth, and precise contour lines for her hands. (fig. 6)

Canvas

All three paintings, i.e., the Bardi-Serzelli *St Praxedis*, the Ferrara *St Praxedis*, and the Kitson *St Praxedis*, are done on canvas. The Bardi-Serzelli painting appears to have been done on a plain weave canvas. As no x-radiographs of this painting were made, automated thread counting could not be applied.[16] In contrast, the Ferrara *St Praxedis*, is executed on a, so called, 'twill weave' canvas. In twill weave canvases the yarns are woven by passing the weft thread over one or more warp threads and then under two or more warp threads. Each weft yarn floats across the warp yarns in a progression of interlacings to the right or left, thus creating a diagonal orientation of the weave pattern. Twill weaves are often designated as a fraction in which the numerator indicates the number of harnesses that are raised (and thus threads crossed), and the denominator indicates the number of harnesses that are lowered when a filling yarn is inserted. The twill weave fraction of the Ferrara *St Praxedis* could thus be read as "two up, one down": 2/1. (figs. 7)

This is in logical contrast to the conventional plain weave, "one up, one down": 1/1, of the Kitson *St Praxedis* under examination. The x-radiographs of the Kitson *St Praxedis* showed that it was executed on a plain weave canvas that has an average of 10 threads per centimetre in the warp, and 10 in the weft direction.[17]

Twill weave canvases are usually associated with the Italian School of painting (the famous 'tela Olona', or the 'Mantelillo Veneziano', being typical for the Veneto), but they appear to occur occasionally in English and French paintings as well.[18] They seem to be absent in Northern or Southern Netherlandish paintings.[19] It is quite telling that such twill weave canvases can be found in paintings that the Netherlandish painter Michiel Sweerts made while he was working in Italy, but none of it can be found in any of the paintings that he made, when back in the Netherlands.[20] Twill weave canvases are hardly ever found in the Netherlands, but appear quite frequently in paintings of Italian origin. While twill weave canvases seem to preferably stay south of the Alps, plain weave seems to occur both north *and* south of the Alps. These findings therefore, would not absolutely exclude the possibility that the Kitson *St Praxedis* could have been made in Italy, but would at least strongly indicate that the Ferrara *St Praxedis* definitely was.

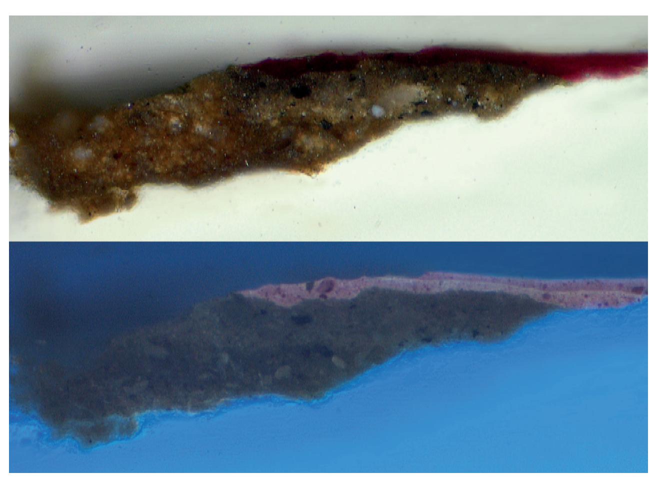


Fig 8 paint cross section from the Kitson *St Praxedis*, showing it done on a single dark ground layer. (222-2, 100x)

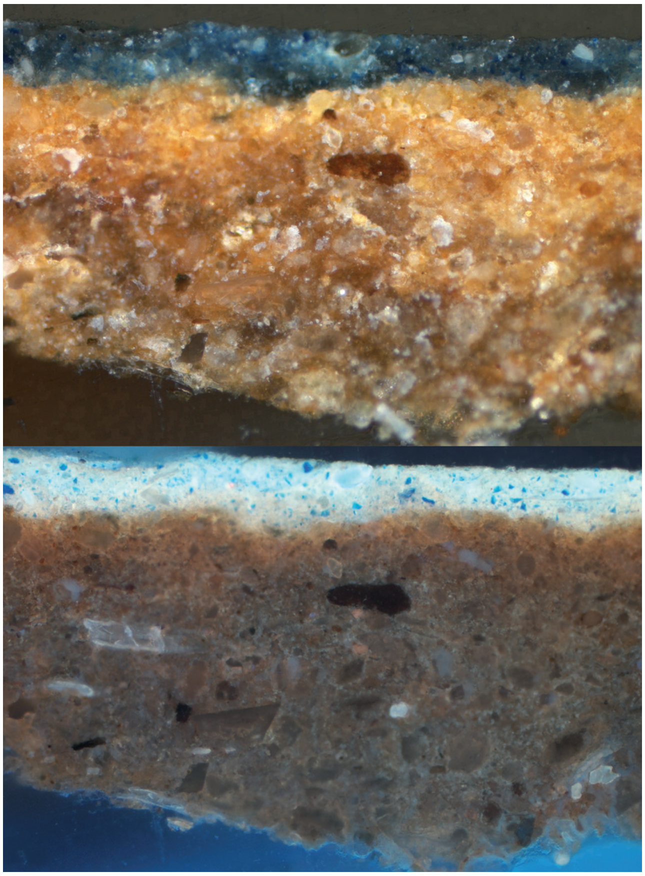


Fig 9 paint cross section from the Ferrara *St Praxedis*, showing the presence of siliceous ground layer (226-1, 200x, BF + UV365)

Grounds

The next points of examination, should be about the, either similar or different, types of ground or priming layers that are on the Kitson *St Praxedis*, and the Ferrara *St Praxedis*.[21]

Examination of a paint cross section (fig. 8) of the Kitson *St Praxedis* shows a rather dark, single ground (possibly applied in two strokes) containing calcite, charcoal black, and a proportion of earth pigments, mainly hydrous iron oxides. Also some associated minerals - paragenetic with the iron oxides - were present, including a few siliceous materials. [22] Elemental analyses of the ground indicate by the peaks for Fe and Mn, the presence of ochres and umbers in the mixture, which together with fair amounts of charcoal black must have given the ground a distinctly dark brownish appearance.[23] The results of the elemental analyses and PLM were further confirmed with x-ray diffraction.[24]

Examination of a paint cross section (fig. 9) of the Ferrara *St Praxedis* also shows this painting to be made on a single ground. This ground too, may have been brought on in two applications. Especially in UV illumination this ground shows to be characterized by the presence of roundish grains, but also of quite prominent angular shards. Elemental analyses indicated the presence of silicon, calcium, titanium, lead, and iron as the main elements. Manganese was present in smaller amounts. Further analyses with light microscopy, x-ray diffraction and micro-chemical analyses, indicated that the ground was mainly composed of earth pigments, comprising a high proportion of silica in the form of α-quartz (SiO_2), and aluminosilicates in rather chunky particles, finer clayey material, natural titanium oxides, such as ilmenite and rutile, calcite and some lead white. The rather tan-brownish colour of the ground is due to the presence of some earth pigments: umbers and ochres. These iron oxides may be paragenetic minerals, naturally associated with the siliceous material, rather than as an intentional admixture. The natural earth ground for the Ferrara *St Praxedis* can probably best be characterised as a so-called quartz/clay ground. The composition of this ground for the Ferrara *St Praxedis* seems in good agreement with the type of preparation described, again, in the Volpato manuscript *Modo da tener nel Depingere*.

In the dialogue between the two painter's apprentices it is stated that the bare canvas was first treated with two coatings of weak parchment glue. Then, after some polishing with a pumice stone, a priming ground was applied with linseed oil. For this ground, any earth could do, but the older apprentices' choice was a 'terra da bocali', some red earth and a little umber. For a Florentine painter like Ficherelli, the source for this 'terra da bocali', i.e. a potters clay, was the pale tan coloured clay dug at Monte Spertoli, some 13 miles from Florence.[25]

Montespertoli (Florence Province) is in a geologically quite interesting environment. It is situated in the Valdelsa Basin, a Late Tertiary and Early Quaternary synform basin, bounded by the Albani-Chianti Mountains to the east and the Livorno Mountains to the west. This basin is filled with over 2000 m of Pliocene to Early Pleistocene continental and coastal-marine sediments. (fig 10)

Within this synform basin, Montespertoli itself is located at an elevation of c. 230 m on the surface of an elongated (60 km long and 25 km wide) NW-SE oriented ridge. This ridge, known as the Montespertoli-Tavarnelle structural High (MTH), separates the Valdelsa River Basin to the west from the Val di Pesa Basin to the east.(fig. 10 b) The historical town lies on a conglomerate layer on top of that ridge with a bedrock characterised by alternations of alluvial, transitional, and marine deposits. Thus, the geological setting of the MTH is characterised by sub-horizontal alterations of pebbly, sandy, and silty-clayey layers. Combinations of marine fossiliferous silty and marly clays, sandstones, conglomerates and bioclastic limestones. Added to these are alluvial deposits (Pleistocene-Holocene) from the rivers in the Valdelsa Basin. Montespertoli is located near the catchments of the Elsa, Virginio, and Pesa

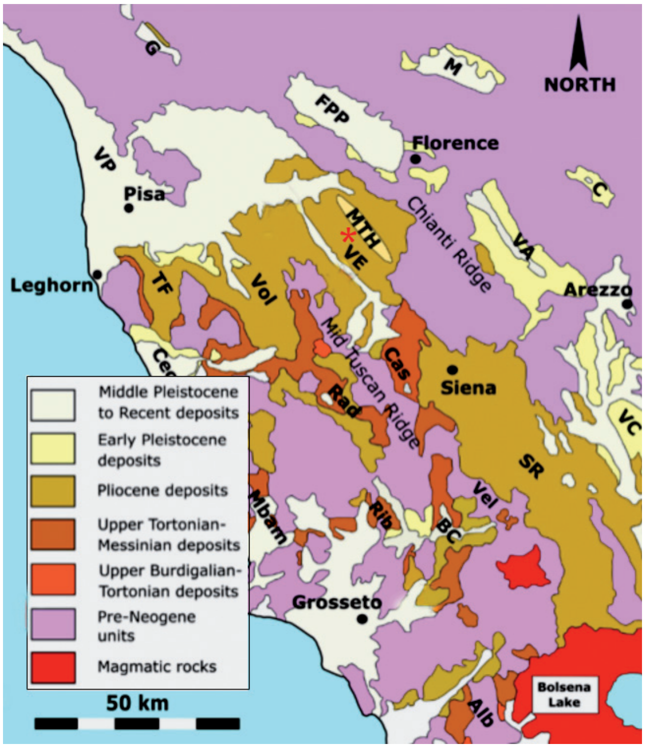


Fig 10a, simplified geological map of Tuscany (after M. Merella *et al*., *Geoheritage* **15** (2023), 82). MTH = Montespertoli-Tavarnelle Structural High.

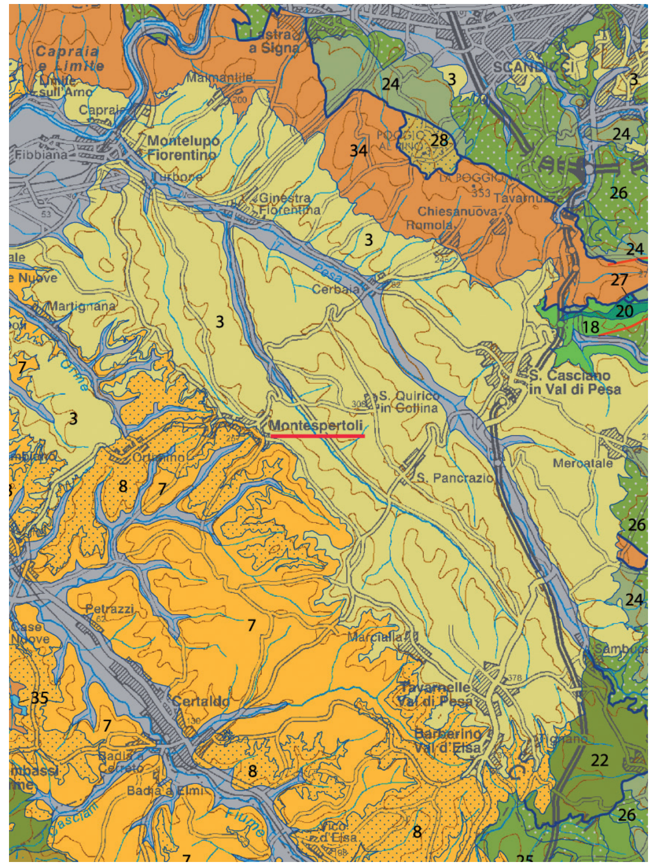


Fig 10 b, detail from *Carta Geologica della Toscana* (note 25) showing the geological environment of Montespertoli. East of MTH = Pliocene-Quaternary Continental Deposits: conglomerates, sands, silts, clay and limestones of fluvial-lacustrine environment; west of MTH = Pliocene-Pleistocene Marine Deposits: clays, silty and marly clays.

Rivers, major left tributaries to the River Arno.(fig. 10 b) Sediments of these rivers are characterised by calcareous, as well as ophiolitic input. Concentrations of Ca, Mn, and Sr (carbonatic input) and Fe, Ti, Co and V are particularly high. The relatively high Al concentration would indicate clay mineral input from Pliocene-Quaternary fine-grained and lacustrine clayey and sandy deposits.[26] The basin's mineral composition is of quartz, feldspars and clay minerals, the most common of which are vermiculite, chlorite, illite and kaolinite.[27]

Such materials give an ideal composition for a painting ground. The very fine clayish particles in the composition are fine enough to conform to the smallest detail of the canvas fibres. (also fig 7 b) Thus, they would provide a good, but flexible adherence. And on the surface side, these particles would be just fine enough to produce a very smooth and slick surface to paint on. The courser sands, silts, and limestone particles of the composition should provide enough bulk to fill up the interstices of the canvas weave. And the inhomogeneous particle size should allow for some flexibility, and prevent the ground layer from cracking.

And indeed, the chemical-, mineralogical composition, and particle size distributions of the ground layer for the Ferrara *St Praxedis* seems to match the Monte Spertoli minerals pretty well.

The use of a chalk-based ground for the Kitson *St Praxedis* would point to a Northern European origin rather than an origin in Italy where such grounds are not common. With the rare exception of the Rembrandt studio after 1648, quartz grounds were not used in the Netherlands.[28] Therefore, the nature and amount of silicate materials in the ground of the Ferrara *St Praxedis* would rather suggest an origin south of the Alps.

Underdrawing

Next, the general composition of the image needed to be laid out over the surface of the prepared canvas. Forms and contours had to be determined before actual painting with full colours could begin.

In most seventeenth-century paintings, the composition was set up in loose dark brushwork over the ground layer(s). That brushwork served as underpainting in which the eventual composition was fixed, volume and substance was given to the forms, and darks and lights were distributed.[29] The most important outlines of the composition were laid out in loose touches, with a brush in a thin wash of warm earth tones. Raw umber, reddish ochres, i.e. hydrous and anhydrous manganese and iron oxides, were used for this purpose. This sketchy approach, done in monochrome warm browns and carbon black, helped to define the shapes and forms of the final composition.

In the case of these two paintings, Ferrara *St Praxedis* and the Kitson *St Praxedis* both being copies, definition of form and dark and light was approached in a different manner. In these cases, there was no need to develop the composition in a conventional monochrome underpainting, nor was there a need to make a sketch for the definition of forms, nor for the distribution dark and light areas. Those issues had already been fully resolved in the completely worked-out image from the exemplar. For the Ferrara *St Praxedis* the copyist would have used the composition, forms and shapes of the Bardi-Serzelli *St Praxedis* as an example. And this copy could very well have been made in Ficherellis's studio.

Using the "Volpato-method", the copyist traced the essential outlines of the Bardi-Serzelli example through the "sandwich" of copying papers to deposit rather loose pigment lines onto the ground of the new Ferrara canvas. These transferred lines should then have served as a the underdrawing for the copy. When the painting was examined with infrared reflectography we found rather faint, and thin, but clearly visible contour lines under the paint layers.[30] These lines were placed to reinforce the mechanically transferred powdery lines.

The pale or white powdery lines (lead white or gypsum according to Volpato) probably did not stand out enough on the rather pale tan coloured silicate ground, to be useful for the next phase of painting. These reinforcing lines, possibly done with a fine graphite stylus, were only drawn to define contours: no attempts were found to render any volume or shadows by hatching. (fig 11)

Within those contours, the necessary underpainting could then be accomplished just by blocking in the outlined areas with their appropriate colours.

There is little doubt that a very similar procedure would have been used to make a copy from the copy, i.e. to make the Kitson *St Praxedis* copy from the Ferrara *St Praxedis.* Both paintings are identical in form and size. An overlay of the two paintings sized to scale shows that the figures – again - are congruent! (fig 12) With the heads, proper left sleeves and knees perfectly aligned, the differences appear to occur mainly in the lower left corner with the ewer and the stone block. Also a slight blurring at the contours of her body is visible. The larger differences are probably caused by accidental shifting of the papers during the tracing process. Those shifts occur quite fre-

Fig 11 infrared reflectogram of the Ferrara *St Praxedis.*

Fig 12 overlay - scaled to size - of the Kitson *St Praxedis* at 50 % transparency in full colour over the Ferrara *St Praxedis*.

Fig 13 infrared reflectogram of the Kitson *St Praxedis*.

quently and come naturally with the process.[31] The slight blurring around the edges of the figure may also have been caused by imprecise tracing; either in copying on the transparent paper from the original, or in tracing with the blunt stylus onto the blank ground of the new canvas. Alternatively, shifting of the papers during the tracing exercise may also have occurred.

The infra-red reflectogram of the Kitson *St Praxedis* (fig 13) does not show any of the reinforced graphite lines that we saw in the Ferrara picture. On the very much darker carbon black-doped ground of the Kitson painting (see fig 8), the white powdery lines from lead white or gypsum probably stood out clear enough. There probably was no need for any reinforcement. The painter could directly begin with filling in the contours with his paints.

Painting reds

The infrared images show that on the Ferrara *St Praxedis*, (fig. 11) those paints around the figure of Praxedis, i.e. the architecture to the left and right in the background and the square block with the urn, and a dark zone of the foreground, are mixtures containing a fair amount of carbon black. The figure itself, however, was - within the well-defined graphite line contours - done in clear and unmixed local colours. No carbon black admixture there. The only instance where we found the use of carbon black in the figure itself are just a few accents in the hair and some touches to increase the contrast between the dark sash and the white of her proper left cuff. Otherwise all the darks and lights of the figure found their expression by the use of mixtures of lead white with a slight touch of red lake pigment being applied directly over the ground. When dry, the modulation of forms in this whitish lively brushwork was covered with glazes of cochineal red lake. Darker tones were not achieved by adding black pigment, but rather through accumulation of red lake glazes. In darker areas, red glazes were simply build up in thicker layers. And by piling up more, up to five or six, intensely coloured glaze layers. In lighter areas remnants of glazes seem merely rubbed in the depressions

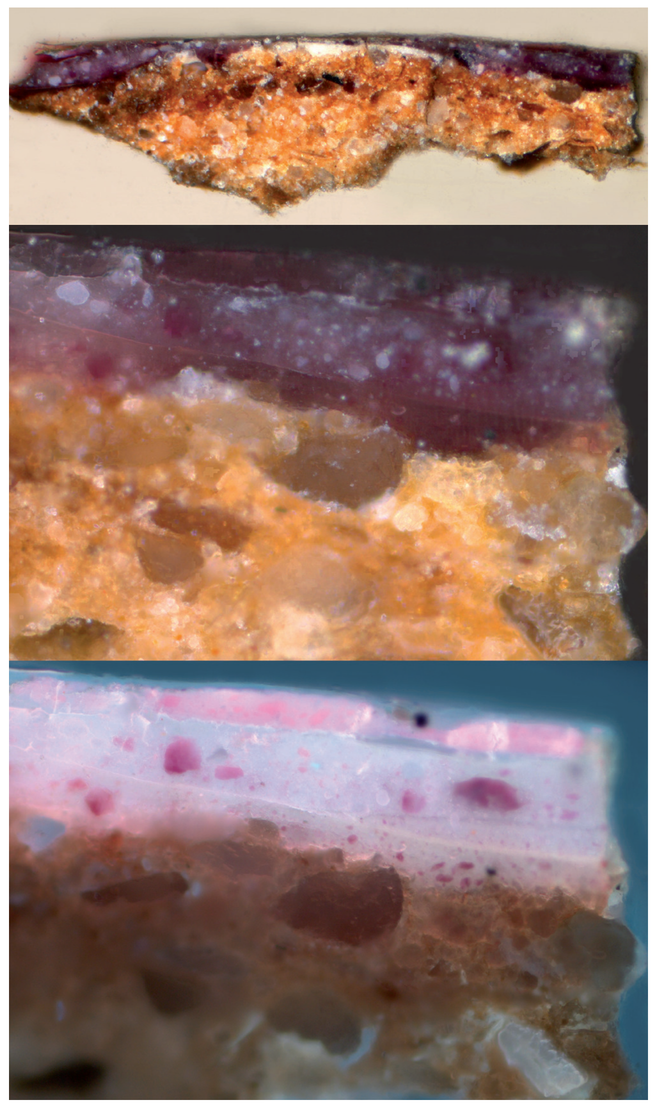


Fig 14 paint cross section (226-6) from pinkish highlight of the red dress of the Ferrara *St Praxedis.*

a = direct polarised light, bright field illumination, mag. 100x. Glazes thinner over lead white highlight; thicker and multiple layers in darker area.

b = detail from a, mag. 500 x; c = detail in ultraviolet illumination ($\lambda = 365$nm)

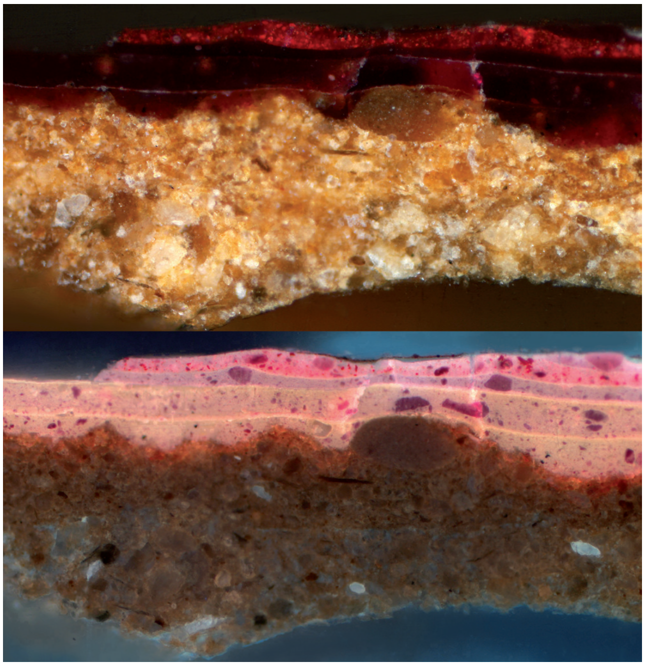


Fig 15 paint cross section (226-2) from the warm reddish fold in the red dress of the Ferrara *St Praxedis.*
a = direct polarised light, bright field illumination, mag. 200x. b = ultraviolet illumination (λ = 365nm)

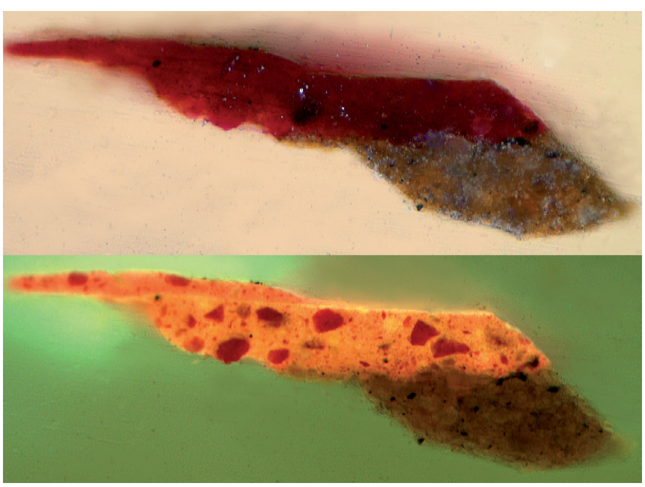


Fig 16 paint cross section (222-2, 200x, UV365 stack) from a darker passage in the raspberry-red dress of the Kitson *St Praxedis*.
a = direct polarised light, bright field illumination, mag 500x, b = ultraviolet illumination (λ = 365nm). Just two layers of cochineal red over the dark carbon black-doped ground.

of the whitish impasto brushwork. (fig. 14 a+b+c) Modulation of forms was accomplished by brushing in the highlights, followed by the thicker and thinner applications of red lake paints over these highlights and directly on the pale-brownish ground layer. Occasionally this was topped off with a mixture of red lake and very slight touches of vermillion.(fig. 15 a+b) The vermillion was probably used to give the harsh and sharp colour of the red lake some warmth. That must also have been the function of the pure vermillion that was brushed over the edges of her sleeves.[32]

In the Kitson *St Praxedis*, much of the dark tone is determined by the use of carbon black in the chalk ground. Carbon black was used lavishly. (fig. 13) And then, on top of this dark tonality, highlights in more or less densely applied lead whites, provided the suggestion of tone and volume. This was then topped off with one, or two, layers of intensely coloured cochineal lake paint.[33] (fig. 16 a+b)

Infrared reflectography is probably the best technique to demonstrate the difference between the two approaches in painting the figures of St Praxedis.

If the infrared radiation encounters a blackbody absorber, such as the graphite or carbon black based pigments, the radiation is severely attenuated by absorption. Those infra-red

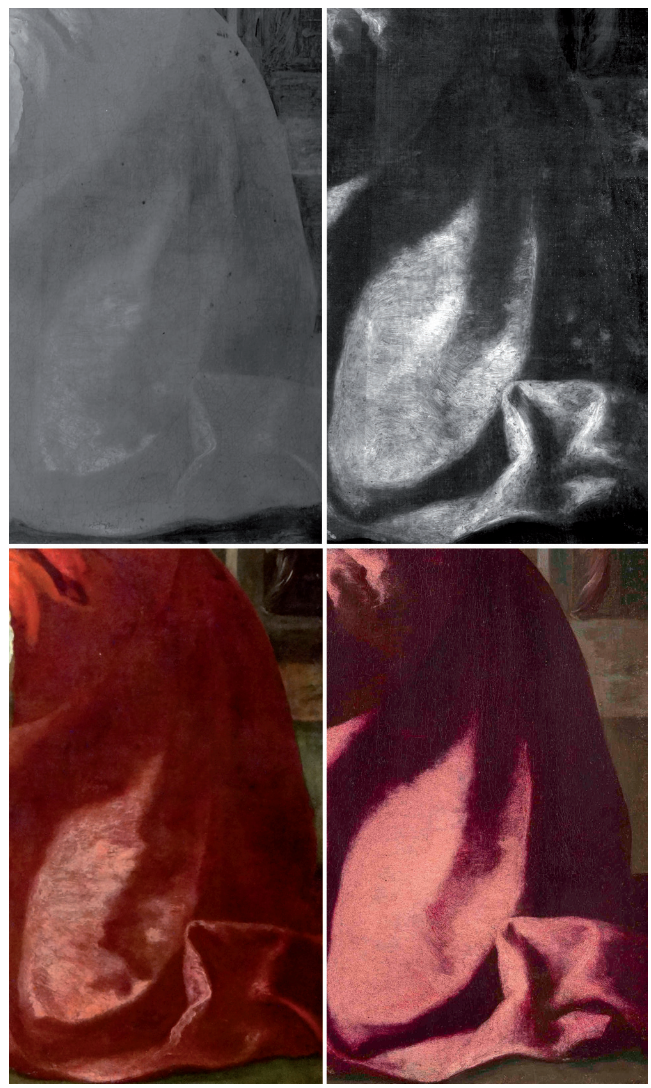


Fig 17 a. infrared reflectogram of detail from the Ferrara *St Praxedis*
b. infrared reflectogram of detail from the Kitson *St Praxedis*
c. detail from the Ferrara *St Praxedis*
d. detail from the Kitson *St Praxedis*

photons that succeed in transmitting through paint layers onto a light priming without any carbon black, are largely reflected back to the camera.

The reflected infrared image of a painting is thus a mixture of black features representing strongly absorbing colorants, with lighter features showing scattering or non-absorbent pigments. The significance of this demonstrates quite well in the comparison between the two paintings in details of the red drapery around Praxedis' left knee. (figs. 17 c+d) The infrared detail of the Ferrara *St Praxedis* does not show any contrast at all. (fig. 17 a) Just barely visible, we see a few brushstrokes in lead white under the red lake glazes to indicate stronger highlights. The infrared photons are largely reflected back to the camera. In the Kitson *St Praxedis*, however, the same area is characterised by a very strong contrasts between highlights and shadows. (fig. 17 b) At first sight, the lighter areas of the red dress in the Kitson painting (17 d) seem to be fairly similar to the lights on the Ferrara *St Praxedis* (17 c). Plain lead white, very thin glaze of red lake over it. But the telling difference is in the dark areas. These darks are not only darker than the equivalent areas on the Ferrara *St Praxedis*, but also more intense. That is not only caused by the mellowing down of the red drapery by the use of vermillion in Ferrara *St Praxedis* (17 c), but also because in her dress the darkest colours are merely determined by the absorption of light through a multitude of layers of red lake. This is in strong contrast with the Kitson *St Praxedis* (17 d), where the reds are exclusively done with a harsh cochineal red lake without any admixture of vermilion. But more than anything else, the infrared detail in the Kitson *St Praxedis*, shows that the darks are determined by the local absorption of the infrared photons, due to the presence of carbon black pigment. There, the folds and pleats of Praxedis' dress were set up by the painter in a very strong light-dark contrast. When this was dry, the artist glazed the whole surface over with a film of red lake. In ultraviolet light the organic lake showed an even and powerful fluorescence. This red film, being slightly too translucent, and therefore showing still too harsh light/dark contrast, was then followed up by a second glaze of the same cochineal red lake. Modelling of forms was then further refined by thinning these glazes, sometimes by blotting away, specifically at the highlights.

In short: In the Ferrara *St Praxedis*, the modulation of forms in the reds was accomplished by adding more and thicker glaze layers in the darker areas, and using admixtures of lead white and vermilion to the glaze for the lighter areas. In the Kitson *St Praxedis*, the modulation of forms was accomplished by painting extreme dark and light contrasts using carbon black. And these extremes were then pulled together by placing a single - or at most a double - uniform film of translucent cochineal glaze over it.[34]

Painting yellows

On most European seventeenth century paintings, lead tin yellow (Pb_2SnO_4) is taken as the pigment of choice for the most bright and shiny golden objects. Not so on both Praxedises. Surprisingly, the bright yellow highlights for the golden handles of the urn at the St Praxedis' knees, on both paintings, were done with mixtures of lead white and yellow ochre, rather than the more conventional lead tin yellow. And also in other areas on both paintings, lead-tin yellow was emphatically absent.

In the painting of the golden handle of the ewer on the Ferrara *St Praxedis*, a layer of bright yellow ochre was directly applied on the clay/silicate ground. Examination of a paint cross section in ultraviolet illumination (λ ex. = 470nm) indicates that this yellow ochre was applied in two layers, of which a lighter one is placed on top of a darker, more brownish ochre. A thick, fluorescent layer on top of this lighter ochre would suggest that a glaze of an organic yellow lake was applied. (fig.

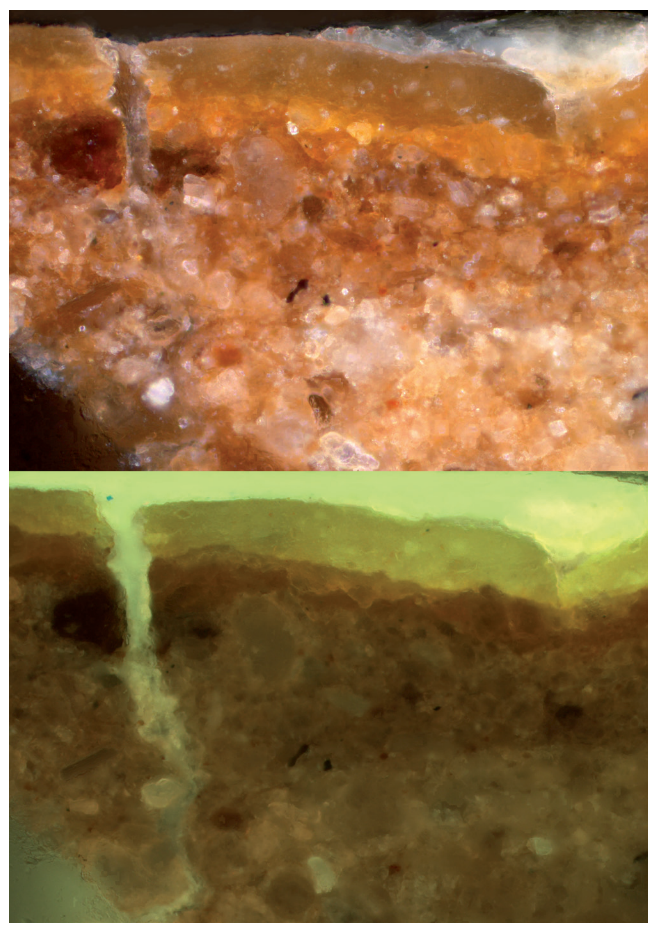


Fig 18 paint cross section (226-4, 500x) from the golden highlight of the ewer on the Ferrara *St Praxedis*.
a = direct polarised light, bright field illumination, mag. 500x. b = ultraviolet illumination (λ = 470nm)

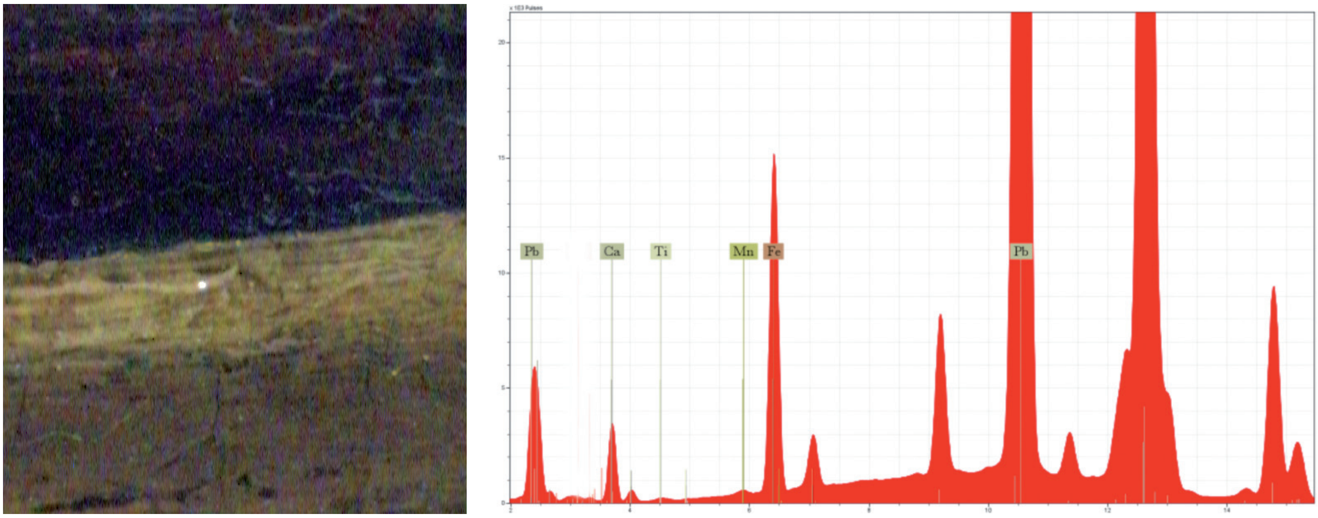


Fig 19 a, detail of the ewer on the Kitson *St Praxedis* white dot = measurement spot; b. x-ray fluorescence spectrum does not show any evidence for lead-tin yellow. Pb consistent with lead white, Fe with yellow ochre.

18). Yellow lake pigments were made by precipitating a specific plant extract (*Reseda luteola*, *Rhamnus cathartica*) onto an aluminium hydrate substrate.

Careful examination on the surface of those very same areas of the Kitson *St Praxedis* with a digital microscope at different ranges of magnification, did not reveal any signs of such yellow lakes.[35] Also concerted efforts under ultraviolet illumination (λ ex = 365nm, and 440nm) were not successful in showing evidence for any remnants of the characteristic yellow flavonoid substances. Here, we just found yellow ochres and lead white.(fig 19)

Painting blue

On both the Kitson *St Praxedis* and on the Ferrara *St Praxedis*, the blue paints turned out to be made of ultramarine.[36] This costly pigment was applied in a seemingly unconventional manner in both cases. For blue passages, most seventeenth-century painters usually started to apply underpaints, or dead colours, with rather economical mixtures of opaque paints. The underpainting of blue draperies or shadows was usually executed in cheap smalt, indigo or azurite, generally mixed with lead white. Once this underpaint was dry, the painter would then proceed by applying a thin translucent glaze of the costly ultramarine.[37] Thus, dead colouring was not only helpful in defining values of tone and colour, it also helped to make a little bit of expensive pigment go a long way.[38] On both paintings, no trace of smalt or any other cheaper dead colour was found, instead the blue skies behind the saints were done with nothing but ultramarine and sometimes a bit of lead white. However, the way in which the ultramarine was applied was distinctly different. That difference does not show

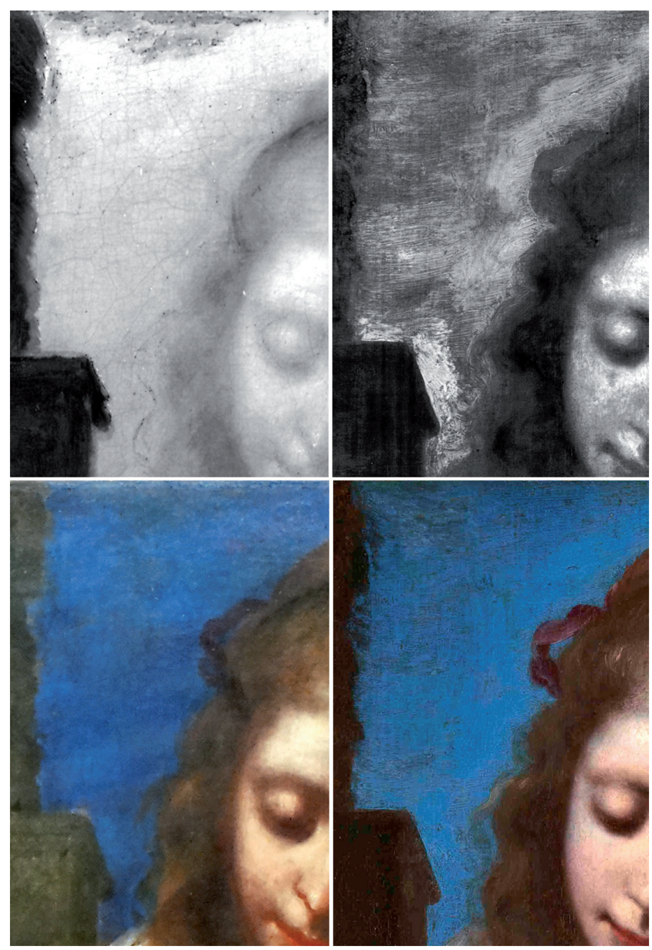


Fig 20 a. infrared reflectogram of detail from the Ferrara *St Praxedis*
b. infrared reflectogram of detail from the Kitson *St Praxedis*
c. detail from the Ferrara *St Praxedis*
d. detail from the Kitson *St Praxedis*

up at first glance. Both skies are of an even and moderately light blue, the one on the Ferrara *St Praxedis*, fairly smooth of a somewhat warmer tone, relative to the one on the Kitson *St Praxedis*, done in a more vigorous brushwork with a slightly cooler tonality. (figs. 20 c and d)

Here again, the examination of the paintings with infrared reflectography turned out to be very informative. The infrared detail of the blue sky to the left behind the saint's head on the Ferrara *St Praxedis* does not show very much contrast. (fig. 20 a) Just barely visible, we see a few of the graphite (?) lines to indicate the curls of her hair. Otherwise, the infrared photons are, almost without any absorption, largely reflected back to the camera. In the infrared image the sky looks smooth and white. A closer look at a paint cross section from the Ferrara painting (fig. 21) shows the cause of this effect. The blue for the sky consists of just a single layer of not extremely good ultramarine. The blue lazurite particles in that layer are accompanied by a fair amount of associated other silicate minerals, and naturally occurring calcite particles. These are all minerals that have refractive indices low enough to be fairly translucent in oils. There is also a small admixture of lead white. But that white just lightens the colour a bit. It does not affect the translucency of the blue paint very much. These minerals do not absorb notably in the infrared. (fig. 20 a) The photons simply pass through and are largely reflected back to the camera. The area therefore, appears whitish in the reflectogram.

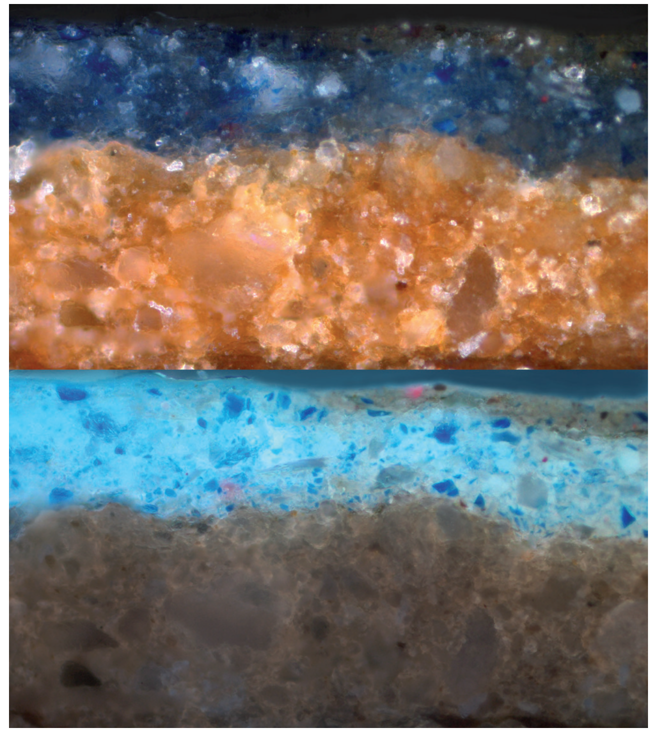


Fig 21 paint cross section (226-8) from the ultramarine blue sky on the Ferrara *St Praxedis*.
a = direct polarised light, bright field illumination, mag. 500x. b = ultraviolet illumination (λ = 365nm)

The lower blue layer on the Kitson *St Praxedis* (fig. 22) is roughly of the same quality as the single blue layer on the Ferrara *St Praxedis*, i.e. moderate quality of lazurite pigments in varying particle size, accompanied by relatively large amounts of associated silicate minerals and calcite. The amount of natural contamination that comes with not extremely refined lapis lazuli mineral. However, in this case, the light that passes through this mixture is <u>not</u> almost fully reflected. Because of the carbon black admixture in the priming layer of the Kitson *St Praxedis*, part of the light is also absorbed. The longer wavelengths of light, i.e. the red (620-720nm) and the infrared (< 800nm) ones tend to get more absorbed, the blue (460-500nm) and green (500-570nm) wavelengths penetrate less, and therefore may be more easily reflected. This could perhaps explain the slightly more greenish aspect of the blue on the Kitson *St Praxedis*.[39] The painter of the Kitson *St Praxedis* must have been troubled by the dark tone of the ground showing through. The infrared image (fig. 20 b) shows that he brushed in thicker, more opaque paints with larger lead white admixture. So much so, that the infrared photons are preferably reflected by the opaque white, before they could reach the ground layer and be absorbed by the carbon black in it. These more opaque paints were rather vigorously brushed in, in an angular 'patch' around the architecture to the left, and almost in a halo of opacity around the saints' head. Clearly, one layer of blue was not sufficient for the Kitson *St Praxedis*. The paint cross section (fig. 22), shows that the first, relatively course and lower quality of blue is covered with a rather thin layer of very fine high-quality ultramarine. Not much contamination there. As the refractive indices of the ultramarine particles are around 1.5~1.522, the underpaint must have appeared fairly translucent.[40] The dark tone of the ground would have shone through. This was usually considered an undesirable property for underpaints. But the painter made effective use of painting as a multilayered system, transmitting and reflecting light in a different manner in each layer. Part of the light gets absorbed and another part gets scattered when the light strikes such a sequence of layers. The way this occurs is determined by the characteristics of each separate layer.[41] The particles of the top layer are very closely packed and mixed with lead white to limit the greyish tonality from the ground, while at the same time making good use of the blue

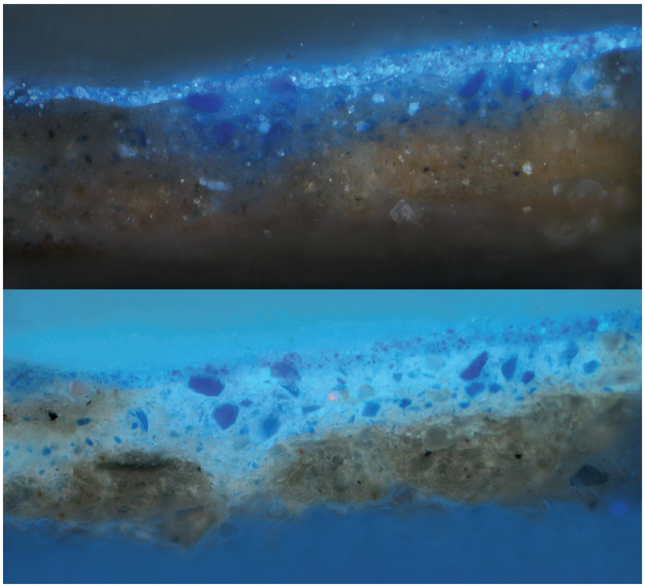


Fig 22 paint cross section (222-1) from the ultramarine blue sky on the Kitson *St Praxedis*.
a = direct polarised light, bright field illumination, mag 500x, b = ultraviolet illumination (λ = 365nm).

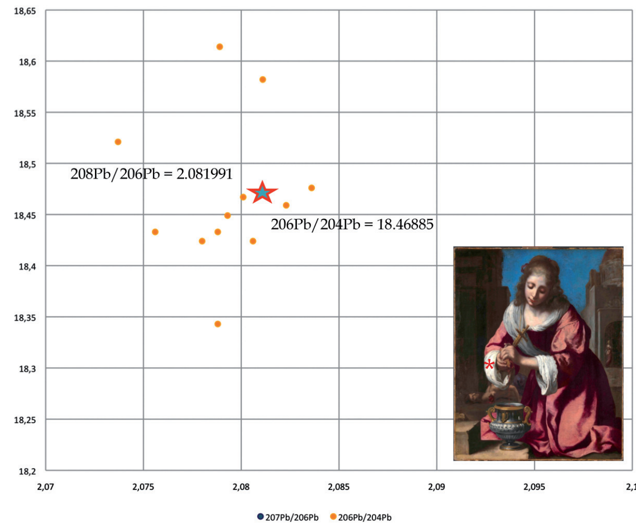


Fig 23 ratios of lead isotopes (^{206}PB/^{204}Pb = 18.46885; ^{208}Pb/^{206}Pb = 2.081991) from white cuff on the Kitson *St Praxedis* (red star) conform to "Netherlandish" ratios (yellow dots) as found on paintings by Vermeer in the National Gallery Washington.

of the dead colour. Supported by the base colour of the underpaint, blue light shines off from just a very thin layer containing small amounts of very good ultramarine. Just enough thickness to provide a good, convincing blue, just thin enough to take full advantage of the dead colour. A very effective trick to make small amounts of costly material go a long way.[42]

Our examinations on the genesis and technical features of the two paintings have resulted in convincing evidence. Although the two paintings look identical, the making of them was accomplished with distinctly different painting techniques. We also found the use of different materials, or the same materials being used in a different manner. The technical features of the Ferrara *St Praxedis* strongly suggest a making in Italy, whereas its Kitson copy has the characteristics of a Netherlandish origin.

This Netherlandish origin may also be confirmed on the basis of lead isotope ratios. Lead occurs in nature as a combination of four stable isotopes (^{204}Pb, ^{206}Pb, ^{207}Pb, and ^{208}Pb), having different masses. The stable isotopes constitute lead compounds in different ratios, depending on their original geological deposit. Thus, the ratio of these lead isotopes is indicative for the source of the lead. Fabian and Fortunato have demonstrated that isotope ratios of lead whites correlate with the geographical origins (Netherlands, Germany, Italy, Spain) of the paintings on which these pigments were applied.[43] This method was also successfully used in 1976 by Keisch and Callahan to differentiate the lead white on genuine Vermeer paintings from Vermeer fakes in the collection of the National Gallery, Washington. That study was based on the assumption that the genuine paintings would be characterized by seventeenth-century "Dutch" ratios, and the forgeries by modern, contaminated ratios. The catalogue of 'authentic' isotope ratios then served in also scientifically excluding the two questioned works from Vermeer's oeuvre. [44] In 2014, dr. Gareth Davies of Amsterdam Free University analysed a small sample of lead white from the Kitson *St Praxedis* with this method.[45] His results confirmed a Netherlandish origin of the Kitson painting.[46] (fig. 23)

The attribution of the *St Praxedis* to Vermeer, was initiated by Kitson because of the date and signature at the lower left. This would read: *Meer 1655*.[47] Many scholars who rejected the attribution, suggested that this signature would be a later addition. They assumed a modern signature paint applied over the surface of an old painting. Therefore, the signature was intensively examined with an advanced digital microscope at a large range of magnifications.[48] These examinations indicated that the signature paint does not run over older cracks, as a newly applied paint would have done. Also observations with a conventional stereo-microscope and later with a hand-held digital microscope, did not reveal anything suspicious about the signature.[49] There was no evidence to suggest that the paint of the signature would not be integral with the rest of the paint. The paint of the signature on the Kitson *St Praxedis* was identified as bone black.[50] (fig. 24) This pigment, a form of charcoal produced by heating animal bones in the absence of air, was a very common pigment in the seventeenth century. It

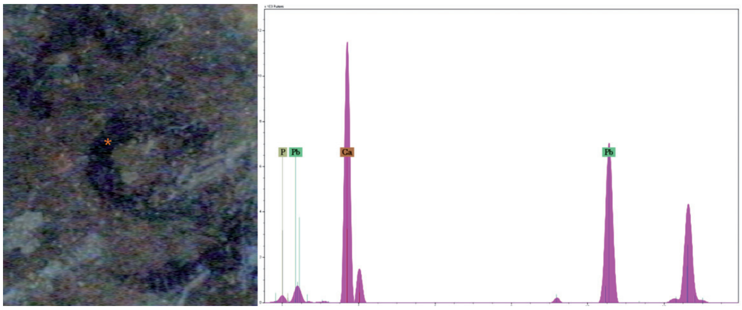


Fig 24a, detail of the signature (letter *e*) on the Kitson *St Praxedis* white dot = measurement spot; b. x-ray fluorescence spectrum subtraction of back ground spectrum from signature spectrum show presence of Ca and P. Consistent for bone black. Pb salts may be present as siccative.

contains up to 20% of elemental carbon, the remainder being made up of calcium phosphate ($Ca_5(OH)(PO_4)_3$, hydroxy-apatite).[51] Also the presence of protrusions of saponified lead white, originating from the lower layer, indicates that the paint of the signature should well be contemporary with the rest of the painting.

When all this evidence is accepted, we may need to reconsider a Vermeer, albeit one that does not really look like a typical Vermeer. The Vermeer with whom we are most familiar, is an artistic personality that existed only after c. 1660. The present, much earlier, painting under investigation seems to be the product of a Vermeer who, at a very young age, had not yet formed his 'signature' style, and personal painterly idiosyncrasies. This outcome confronts us with questions about artistic choices that seem to be in serious conflict with other Netherlandish seventeenth-century paintings. The *St Praxedis* is indeed 'in theme and conception wholly typical of the Florentine Seicento'.[52] And these approaches seem foreign to the conventions of Dutch 17th-century painting. St Praxedis was a rather obscure saint, a 2nd-century Roman virgin and martyr who was revered for having cared for Christian martyrs after their deaths. Not even a well-known subject in staunchly catholic countries.[53] Why would a beginning painter in the Calvinist Dutch republic start his career with making such an Italian style Catholic painting?

Love and devotion

Vermeer was born in 1632 in a protestant family and baptised in the reformed church. However, on 20 April 1653, converted to the old religion, he married Catharina Bolnes in the *schuilkerk* Hodenpijl in the village of Schipluiden. This schuilkerk was a (semi) clandestine catholic hidden church dedicated to Ignatius of Loyola, the founder of the Jesuit Order.[54] Hidden churches were fully decorated Catholic churches hidden behind the facades of ordinary houses. Hodenpijl was probably chosen over Delft, because in that hidden church, their ceremony could take place without disturbance. At that time catholic ceremonies were forbidden by the civil authorities in Delft. Vermeer's conversion must have been a strong act of love and/or of faith. In seventeenth-century Netherlands, such a move implied several serious social and economic disadvantages. For members of the catholic community it was not possible to hold any public office. The couple eventually went to live in the Papenhoek (the Papist's Corner), an area in Delft almost exclusively inhabited by adherents of the catholic religion. Their neighbours on the Oude Langendijk were local Jesuit priests, who also ran the local catholic hidden church. Vermeer and his family maintained a strong connection with the Jesuit Order and that church, and the Jesuits played a considerable part in Vermeer's working practice and iconography.[55]

The most important Jesuit priest in Vermeer's life must have been Isaac van der Mije. Born in Delft in December 1602, he ended up in Mechelen (Malines) some 20 kilometres south of Antwerp, where he entered the Jesuit order on 20 September 1623. He had expressed his desire to be send for missionary work to India or Ethiopia, but instead was send (1639) for missionary work in the Dutch Republic, the so-called *Missio Hollandica*. After having worked in several cities, Van der Mije was assigned to Delft in 1650. There he oversaw the reconstruction of the hidden church, that got severely damaged on the gunpowder explosion of 13 Oktober 1654. His renewed hidden church was made to accommodate 700 persons and was provided with new catechetical art works. No doubt, these art works would have been of Counter Reform nature.[56]

The Jesuits used the arts as means of articulating their message of the Catholic Church 's dominance over Christian faith. It was one of their primary tools of propagation for the counter-reformation.[57] They wanted their religious imagery to defend orthodoxy against Protestant iconoclasm and to reassert ecclesiastical authority. Therefore, they encouraged art, as long as it was religious in content, and would glorify God and the Catholic traditions. After all, it was the founder of Jesuit order, Ignatius of Loyola, who recommended in his *Spiritual Exercises*, that the faithful place before their mind's eye images of the Passion and the feats of the saints.[58] Jesuit art was aimed to move viewers and encourage emotional reactions to aid the faithful in atonement for Christ's sacrifice. They had a taste for the dramatic and theatrical.[59] And there was not very much appreciation for understatement. On the contrary, they rather wanted their paintings to be very powerful statements that could encourage pious reflection and contrition. They saw the function of art as a defence of Catholic tenets that were denied by Protestants. And so, the subject matter was, of course, often about the very things that the Reformation had abandoned:

Fig 25 a, the castle of Rhoon, leaded glass panels at ground floor,
b characteristic pattern of leaded glass in the "empire room" recurring in many Vermeer paintings. In centre is the specific coat of arms of Alverade van Wendelnesse.

the sacraments and the traditional saints. Thus, a depiction of a 'blood-sopping' saint may not have been quite suitable in the conventions of secular 17th- century Dutch painting, but it would definitely fit in the counter-reformation religious imagery of the time.[60]

Castle Rhoon

Isaac van der Mije was not only a Jesuit priest, he was also a painter. Before he joined the Jesuit Order he had received a regular 8 years of training as a painter. He seems to have put that training to good use during the time that he was assigned to the castle of Rhoon. (fig. 25 a) Despite the religious ban of 1580, the Lords of Rhoon had remained catholic during the 16th and 17th centuries. First, they had built a catholic church near the castle, but that one was confiscated by the protestants. They then decided to hold their catholic service / mass in the castle itself. For that purpose they had a house chapel for private sermons constructed on the first floor. From the late 16th century until 1683 the castle housed many Jesuits for shorter or longer periods of time and functioned as a small, but significant catholic refuge.[61]

In the time of Pieter-VIII van Rhoon (castle lord 1635-1679), Isaac van de Mije was appointed in 1645 as huiskapelaan (house chaplain) to work there until 1650.

Those religious duties for just one family would not have taken much of his time and he seems to have spent much of his time in making paintings for the chapel. Sadly, we do not know what these paintings looked like as the castle's church hall and chapel room have seen several later renovations. And upon the family's departure from Rhoon Castle, the last owner emptied the chapel of all its' furnishings.[62] Now, only a few architectural details remain. Since he had spent, after his entering into the Jesuit Order, some 15 years in the Antwerp region, there is a fair chance that in style, technique, and iconography Van de Mije's paintings would have conformed to the Flemish tradition. That would certainly not have been exceptional. In the Antwerp region, there was a strong involvement of the Jesuits in art, both on a theoretical (Aquilonius), and on a technical – practical level.[63]

But Van de Mije was not the only painter visiting or staying at Rhoon Castle. Slager has convincingly demonstrated that Vermeer had used the castle's rooms for the location of many of his interior scenes. Some of the castle's windows still have a highly characteristic 15-block leaded glass pattern with the coat of arms of Alverade van Wendelnesse, the previous owner of the castle. (fig. 25 b) And on several of Vermeer's paintings this very same coat of arms can be found![64]

The establishment of the connections between Vermeer, Van de Mije, and Rhoon Castle, may provide new clues about

Vermeer's training as a painter. When, some eight months after his marriage, he was accepted into the St. Luke guild in December 1653, his registration fee was six guilders. That would imply that he had not served a full apprenticeship with an established Delft master. The official requirements of apprenticeship were at least four to six years. For an aspiring painter the fee would have been just three guilders, if the candidate had served his full time with a Delft master.[65] Therefore, Johannes Vermeer may well have pursued his studies outside of Delft. Several arguments are proposed that Van de Mije, a one generation older painter, could have could have worked in the role as teacher with Vermeer at Rhoon Castle.[66] The training of the young Vermeer by the Jesuit Isaac van de Mije could have taken place at some point(s) between c.1645 and 1653, the date of his acceptance in the Delft guild. And much, if not all, of this teaching may have taken place at Rhoon Castle. Vermeer was only 18 years old when Isaac van de Mije came to Delft. Guild candidates were required to pass a compulsory master's test, in which they had to produce their masterpiece of professional standards.

Signatures

In this context it is tempting to speculate further on the signatures under the Kitson *St Praxedis*. The painting also has a second, mysterious, and poorly legible inscription on the lower right edge. The paint of this inscription too, is found to be integral to the rest of the paint structure. It is difficult to read as it is very heavily abraded and is done in light ochre paint on a darker ochre earth colour.[67] Wheelock has read the remnants of this inscription as: "Meer N R..o.o".[68] He interpreted this as: "Meer N(aar) R(ip)o(s)o", i.e. "Vermeer, after Riposo".

This reading seems very questionable. Riposo was indeed the nickname of Felice Ficherelli, the maker of both the Bardi-Serzelli *St Praxedis*, and the Ferrara *St Praxedis*. And indeed, he seems to have been given that name by his Florentine colleagues because of his easy-going character. However, it would seem quite unlikely that the young Vermeer in Delft would know about a nickname that was only current in a small circle in Florence. If he would have wished to indicate on his Kitson *St Praxedis* copy, the name of the maker of Ferrara *St Praxedis* exemplar, he certainly would have used the artist's real name.

An alternative interpretation seems possible. Rather than to an artist's nickname Riposo, could the inscription have referred to Rho(o)den, R(o)oden, R(h)oeden, or any other of the latinized versions like Rhoona, Rhoonae and Roodiorum, that the Jesuits frequently used in their texts addressing Rhoon?[69]

Conclusion

Some art historians consider a painting of *St Praxedis* to be an autograph early painting by the Dutch painter Johannes Vermeer. This painting is a faithful copy of an Italian painting with the same subject by Felice Ficherelli. Both paintings look very similar. And both paintings show quite prominent seventeenth-century Italian stylistic features. Art-technical studies, however, have shown that the making of both paintings was accomplished with distinctly different painting techniques. We found the use of different materials, or the same materials being used in a different manner. Different materials, different methods. Art technological studies also convincingly demonstrated that the copy must have been made in the Netherlands, whereas its exemplar would have been made in Italy, and more specifically in the Florentine region.

The present study on genesis and technical features of both paintings would confirm that the attribution of the copy to Vermeer could be correct. The establishment in this respect of connections between Vermeer and the Jesuit community at Rhoon Castle may provide new clues about Vermeer's training as a painter.

Acknowledgements:

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Notes

1 For Prof. Dr. J.R.J. van Asperen de Boer
2 It was this uncertainty that provided Van Meegeren with the opportunity to launch his forgeries. F. Lammertse, N. Garthoff, M. van de Laar, and A. Wallert, *Van Meegeren's Vermeers*; The Connoiseur's Eye and the Forger's Art, Rotterdam, Museum Boijmans Van Beuningen, 2011.
3 The painting is now in the in the National Museum of Western Art, Tokyo. A.K. Wheelock, 'Saint Praxedis: New Light on the Early Career of Vermeer', *Artibus et Historiae* 14 (1986), 71-89, and A.K. Wheelock, 'Saint Praxedis', *Vermeer and the Art of Painting*, New Haven/London, 1995, 21-26, in agreement with M. Kitson, 'Current and Forthcoming Exhibitions: Florentine Baroque Art in New York', *Burlington Magazine* 3 (June 1969), 409-410.
4 A.K. Wheelock, Jr., "St. Praxedis": the Earliest dated Painting by Vermeer', J. Grabski (ed.), *Jan Vermeer van Delft, St. Praxedis*, IRSA, Vienna, Cracow, 1991, 8-21., figs. 2 and 3. The last digit of the date may possibly read as 3 instead of 5.
5 Suggestions were made that the choice for this peculiar subject matter might be related to Vermeers marriage "into a family with strong Jesuit inclinations", and his recent conversion to Catholisism. Wheelock, 1995, p. 24: "Vermeer must have become involved with Jesuit theological concerns in the mid-1650s at the time of his conversion to Catholisism".
6 'J. Boone, 'Saint Praxedis: Missing the Mark', http://www.essentialvermeer.com/, accessed 15.VII.2014
7 Kitson, 'Current and Forthcoming Exhibitions', *op. cit.*, (note 2), p. 409.
8 To avoid confusion in the discussion the *St Praxedis* in the Fergnani collection in Ferrara will be indicated as the 'Ferrara *St Praxedis*', the *St Praxedis*, formerly in the Piasecka-Johnson collection as the 'Kitson *St. Praxedis*', after the first scholar who attributed it to Vermeer.
9 https://www.dorotheum.com/en/l/460552/
10 F. Baldinucci, *Notizie dei Professori del Disegno da Cimabue a Qua*, Firenze 1681 (ed. 1717), p. 221.
M. Gregori, 'Felice Ficherelli', in: *Il Seicento Fiorentino. Arte a Firenze da Ferdinando I a Cosimo III*, exhibition catalogue, Palazzo Strozzi, Florence 1986, vol. II, p. 88
11 Florence, Galerie degli Uffizi, Gabinetto degli Stampe e Disegni, inv. no. 3705 S
12 Infrared reflectogram by Dr. Poldi published in the Dorotheum catalogue: https://www.dorotheum.com/en/l/460552/
13 P. Hetherington (ed.) *The 'Painter's Manual' of Dionysius of Fourna* (an English Translation, with commentary of Cod. Gr. 708 in the Saltykov-Shchedrin State Public Library, Leningrad), London Sagittarius Press, 1974, p. 5.
14 M.P. Merrifield, *Original Treatises on the Arts of Painting*, John Murray London, 1849, Dover Publications, New York, 1967, vol. II, 721-758, in particular pp. 734-735.
For the relationship of Volpato with Jesuit painters and scholars see: C. Gramatke, 'The Jesuit contribution to written art technological sources in the 17th and 18th centuries', in S. Eyb-Green, J.H. Townsend, K. Pilz, S. Kroustallis, and I. van Leeuwen (eds), *Sources on Art Technology; Back to Basics* (proceedings of the sixth symposium of the ICO-CC working group for art technological source research, Archetype London (2016), 107-114.
15 An equivalent division of labour, including a similar methods of transfer copying, was described in Vicente Carducho's dialogue between a master and his disciple: *Diálogos de la Pintura* (1633). Carduccio was born in Florence and got his training as a painter in the group of Italian painters working in Spain. Z. Veliz, *Artists' Techniques in Golden Age Spain*, Cambridge University Press, 1986, p. 21, 27-28.
16 For the methods, possibilities and limitations of automated thread counting procedures, see: C.R. Johnson and R. Erdmann, 'Vermeer Canvas Study', update on project status December 2013, (internal report). Counting Vermeer-RKD: https://countingvermeer.rkdstudies.nl/.
17 Evaluation of the results showed a dramatically strong cusping of the textile at the left hand side. Some 8 x-radiographs were made. (44kV, 2.7 mA, 35 sec. 95 cm, Agfa Structurix D4 films) The radiographs were scanned at 600 dpi resolution and digitally assembled. Images can be consulted at the website: Counting Vermeer (note 15)
18 K. Vanderlip Carbonnel, 'A Study of French Painting Canvases', *Journal of the American Institute for Conservation*, 20 (1980), 3-20., Also: D.H. Johnson, C.R. Johnson, R.G. Erdmann, 'Weave analysis of paintings on canvas from radiographs', *Signal Processing*, 93 (2012), 527-540, http://dx.doi.org/10.1016/j.sigpro.2012.05.029, accessed 16.VII.2014. Twill weaves were often woven on wider looms and thus permitted the production of large sturdy canvases without seams. Such types of canvas could also be appropriate for sails of ships.
19 The only, quite notable, exception would be Rembrandts originally gigantic (550 x 550 cm) *Conspiracy of the Batavi under Claudius Civilis*, oil on canvas, now 196 x 309 cm, Nationalmuseum, Stockholm, inv. nr. NM 578.
20 A. Wallert and W. de Ridder, 'The Materials and Methods of Sweert's Paintings', G. Jansen and P. Sutton (eds.), *Michael Sweerts (1618-1664)*, Zwolle, 2002, 37-47.
21 No samples from the Bardi-Serzelli *St Praxedis* were available for analysis. Visual examination suggested a brownish coloured ground.
22 Polarized light microscopy (PLM) was done with a Zeiss Axio Lab. A1 microscope at mag. 200x. Calcite was identified as colourless, highly birefringent particles with refractive indices slightly lower than that of the binding medium of 1.662. They tended to show as rhombohedra with parallel extinction. There was also the presence of a number of coccoliths in the microsample with an undulose extinction.
23 Elemental analyses were done with a Bruker Artax μ-x-ray fluorescence spectrometer, 50kV, 600μA, Mo-anode, 0.060 μm capillary lens, 120 sec. The XRF spectrum also showed next to the Fe, and Mn peaks, also significant peaks for Si, some S, Cl, fair amounts of K, large amounts of Ca, some Ti, and traces of Cu, and Zn, and some Pb. In the spectra of the ground the peaks for Ca and Fe were most prominent (Ca > Fe >Pb >Mn > K)
24 Debye-Scherrer powder diffraction (XRD) patterns were obtained with 57.3mm cameras with Gandolfi mounts, with a micro-sample in cedar oil on the tip of a glass spindle. Exposures varied from 4-7

hours. CuKα radiation (λ = 1.542Å) was used at 40kV, with tube current of 30mA. All intensities were estimated visually. XRD was also done with the Bruker GADDS (general area diffraction detection system) in 2Theta mode from 16.60° to 67.80° with total step time of 300 sec. Both analyses showed a perfect match with standards for calcite ($Ca(CO)_3$), quartz (SiO_2), hematite (Fe_2O_3). A few lines for gypsum ($Ca(SO_4)(H_2O)_2$) almost approximate the noise level. Their presence is estimated to represent at most a half percent of gypsum, probably caused by deterioration of the calcium carbonate.

25 F. Baldinucci, *Vocabolario Toscano dell'Arte del Disegno, nel quale si explicano I propri termini e voci, non solo della Pittura, Scultura & Architettura; ma ancora di altre Arti a quelle subordinate, e che abbiamo per fondamento il Disegno*, Florence 1681. Also Merrifield, *Original Treatises on the Arts of Painting*, (note 12), pp. 730-733.
For these priming grounds there seems to be a preference for locally obtained clays. Francisco Pacheco from Sevilla advised in 1649 to use his local clay in Sevilla. In his description, the whole procedure of preparation is identical to the process prescribed in the Volpato manuscript. Antonio Palomino describes in his 1715, *El museo pictórico y la escala óptica*, the use in Andalusia of fresh river clay sediment, or fullers earth for the priming layers. Z. Veliz, *Artists' Techniques in Golden Age Spain*, Cambridge University Press, 1986, pp. 68 and 150.

26 P. Diendorfer, *The Geochemical Landscape of the Arno River Basin (Tuscany, Italy)*, Master's Thesis 2021, Chair of Geology and Economic Geology (610), University of Mining, Leoben (TU Austria), pp. 7, 38. Due to seismic activity, different useful layers of these sediments are often exposed at the "Tavarnelle Montespertoli structural High". M. Coltorti, S. Tognaccini, 'The gravitational landscape of Montespertoli (Valdelsa Basin, Tuscany, Italy): State of activity and characteristics of complex landslides', *Geomorphology*, 340 (2019), 129-142. (https://doi.org/10.1016/j.geomorph.2019.04.030)

27 A. Bencini and P. Malesani, 'Fiume Arno: acque, sediment e biosfera', *La Colombaria*, (Accademia Toscana, Scienze e Lettere), studi 133 (1993), 115. Diendorfer, p. 8. Also M. Benvenuti, D. degli Innocenti, 'The Pliocene Deposits in the Central-Eastern Valdelsa Basin (Florence, Italy) Revised through Facies Analysis and Unconformity-bounded Stratigraphic Units', *Rivista Italiana di Paleontologia e Stratigrafia*, 107, **2** (2001), 265-286. Also see: L. Carmigniani, P. Conti, G. Cornamusini, *Carta Geologica della Toscana*, CGT Centro di Geo Tecnologie, Universita degli Studi di Siena, (downloadSupplement (tandfonline.com).

28 K.M. Groen, 'Earth Matters; The origin of the material used for the preparation of the Night Watch and many other canvases in Rembrandt's workshop after 1640', *Art Matters*, III (2005) 138-154. In the ground of a painting by the Dutch painter Dirk van Baburen, laterite and a micaceous/illitic type of clay was found. However, that painting was probably made during his stay in Rome. L.E. Plahter, U.S. Plahter, 'The Young Christ among the Doctors'by Teodoer van Baburen; Technique and Condition of a Dutch Seventeenth-century Painting on Canvas', *Acta ad Archaeologiam et Artium Historiam Pertinentia*, III (1983), 183-229.

29 The use of a monochrome as equivalent to dead colour may explain the term. However, the term is ambiguous. N. van Hout, 'On dead colour', *Antwerp Royal Museum Annual*, 2008, 8-188. Also: N. van Hout, *Functions of Dead Colour*: *underdrawing and other underlying stages in the work of Peter Paul Rubens*, (PhD thesis) Leuven.
Baldinucci, *Vocabolario Toscano dell'Arte*, op. cit. (note 24), 005.

30 Infrared reflectography (IRR) was done with an Osiris 512 x 512 infrared camera, equipped with a Hamamatsu (G11135-512DE), InGaAs image sensor allowing a 4096 x 4096 pixel capture area. The sensitivity in the NIR region extended to approx. 1700nm. The instrument is equipped with a Rodagon 1:5,6 lens, f=150 mm IR. For close-up examinations, the instrument was fitted with a dedicated f=75 mm macro lens. Visible light was filtered out at 875nm with a Schott RG830 filter.

31 G. Korevaar and G. Tauber, 'Gerard ter Borch Repeats; On Autograph Portrait Copies in the Work of Ter Borch (1617-1681)', *Bulletin of the Rijksmuseum*, 4 (2014), 348-381.
G. Tauber and A. Wallert, 'Techniques of Reproduction in the Studio of Ter Borch', accepted for publication *ArtMatters*, 2024.

32 During our study of the painting in Ferrara, examinations of the elemental compositions were also done directly on the painting, using a handheld Olympus X-ray Fluoresence Spectrometer equipped with a 40kV rhodium (Rh) anode and a silicon drift detector (SDD). On these specific reddish areas, the instrument showed strong peaks for Hg and S, the elements that constitute mercuric sulphide pigment vermilion.

33 Cochineal was identified by M. van Bommel of RCE using high performance liquid chromatography coupled with diode array detection (HPLC-DAD). The sample was treated with methanolic hydrochloric acid for 10 minutes, evaporated to dryness and then dissolved in dimethyl formamide (DMF). Analysis was done on a Luna C18 column (100 x 2 mm Phenomenex, Torrance, CA) with a gradient of water, methanol and phosphoric acid. see M.R. van Bommel, 'The analysis of dyes with HPLC coupled to photodiode array and fluorescence detection', *Dyes in History and Archaeology*, 20 (2001), 30-38.

34 This practice has also been found in later paintings by Nicolaas Maes: L. Sozzani, 'Nicolaas Maes, 'An Unanticipated Use of a Red Glaze', *poster preprint IIC*, Dublin 1998, also L. Sozzani, C. McClinchey, 'Portrait of a Lady and the Painting Techniques in the Late Paintings of Nicolaas Maes', *Study and Conserving Paintings, Occasional Papers on the Samuel H. Kress Collection*, Archetype Publications, London & Institute of Fine Arts, New York University, 2006, 170-193

35 HIROX KH-7700 digital microscope with 2.11 megapixel CCD sensor, res. max. 10.000 x 10.000 pixel, magnifications 35x – 2000x.

36 Pigments were identified on both paintings with polarised light microscopy (PLM) and microchemical analysis (MCA)

37 A good example could be found in the painting by Pieter de Ring, *Still Life with a Golden Goblet*, oil on canvas, 100 x 85 cm, RMA inv. no. sk-a-335, where a large area of very precious ultramarine was underpainted (dead coloured) with a very cheap mixture of indigo and lead white. E. Hermens, M. van Eikema Hommes, and A. Wallert, entry '7. Still Life with a Golden Goblet', A. Wallert, (ed) *Still Lifes: Techniques and Style*; An Examination of Paintings from the Rijksmuseum, Amsterdam, 1999, 65-68.

38 Van Hout, 'On dead colour', op. cit.(note 28), in particular pp. 26-27.

39 A. Kienle, L. Lilge, I. Vitkin, M. Patterson, B. Wilson, R. Hibst, and R. Steiner, 'Why do veins appear blue? A new look at an old question',

Applied Optics, 35 (1996), 1151-1160

40 J. Plesters, 'Ultramarine Blue, Natural and Artificial', A. Roy (ed.) *Artists' Pigments, A Handbook of Their History and Characteristics*, vol. II., NGA, Washington/Archetype, London, 2012, 37-66.

41 P. Kubelka, F. Munk, 'Ein Beitrag zur Optik der Farbanstriche', *Zeitschrift für technische Physik*, 12 (1931), 593-601 (translation by Steve Westin, http://graphics.cornell.edu/_westin/pubs/kubelka.pdf).

42 J.R.J. van Asperen de Boer, 'On a rational aspect of Van Eyck's painting technique', *Studies in Conservation*, 18 (1973), 93-95. Also M. Mohamadi, R.S. Berns, *Verification of the Kubelka-Munk Turbid Media Theory for Artist Acrylic Paint*, art-si.org, Rochester Institute of Technology, Rochester, NY (2004).

43 D. Fabian and G. Fortunato, 'Tracing White: A Study of Lead White Pigments found in Seventeenth-Century Paintings using High Precision Lead Isotope Abundance Ratios', J. Kirby, S. Nash, and J. Cannon (eds.) *Trade in Artists' Materials, Markets and Commerce in Europe to 1700*, London 2010, 426-443.

44 B. Keisch, R.C. Callahan, 'Lead Isotope Ratios in Artists' Lead White: a Progress Report', *Archaeometry* 18 (1976), 181-193.

45 For this study the analyses were accomplished with thermal ionisation mass spectrometry (TIMS) Analyses for isotope determination were done by R. Smeets, B van der Wagt, and G. Davies (head of department of mass spectrometry) at the faculty of earth sciences, Free University Amsterdam. The instrument was a Finnegan mass spectrometer. The samples were transferred from the standard glass "well-slides" to PFA beakers in the "clean-lab", and following a series of treatments dissolved in acetic acid, nitric acid, treated with HBr over AGIX8 200-400 mesh, anion exchange columns in accordance with the standard procedure.

46 Unpublished report by G. Davies to the Rijksmuseum Amsterdam, dated April, 2014. See: G. Davies and P. d'Imporzano, 'Myths and Legends: the Reality of Lead Isotope Studies for Cultural Heritage', *Vermeer II*, *New Research on Vermeer*, (proceedings of the Vermeer Symposium, 28-29 March 2023), RMA and Hannibal Publishers, Bruges, (B), 2025 (forthcoming). Also: P. d'Imporzano, *et al.*, 'Time dependent Variation of Lead Isotopes of Lead White in 17th Century Dutch Paintings', *Science Advances*, 7 (2021), nr. 49, (www.science.org/doi/10.1126/sciadv.abi5905)
Samples from the Ferrara *St Praxedis* have also been submitted for analysis. Those results, however, are not yet available. We expect them to conform to Italian isotope values.
(The values for the sample from the Kitson *St Praxedis*, are so close to those of the lead white on Vermeers *Diana and Her Nymphs*, that I am tempted to speculate that the lead white for both paintings might have come from the same batch of pigment.)

47 Wheelock, "St. Praxedis": the Earliest dated Painting by Vermeer', *op. cit.* (note 3), fig. 2. Kitson *op. cit.* (note 2), p.410.

48 HIROX KH-7700 digital microscope (note 34)

49 Wild M8 Heerbrugg stereo microscope mag. 6x~50x. DinoLite AM413TL 10x~50x, 200x. This tallies with observations by Libby Sheldon of University College London, who examined the painting at Christie's on 5.VI.2014., and the observations by A.K. Wheelock, in *Artibus et Historiae* 14, 7 (1986), 71-89.

50 Pigment identification with PLM (see note 21). This was confirmed on the basis of the identification of Ca and P (for calcium phosphate, i.e. bone black), in the black paint by x-ray fluorescence measurements (see note 22).

51 J. Winter, E. West FitzHugh, 'Pigments based on Carbon', B.H. Berrie (ed.) *Artists' Pigments,* A Handbook of Their History and Characteristics, vol. IV (2007), 1-37.

52 Kitson *op. cit.*, (note 2), p. 410

53 This is the only painting made of her north of the Alps.

54 There is no archival evidence left to document the conversion of Vermeer to the catholic church. However, a marriage without previous conversion is extremely unlikely. It is known that the priest who did the wedding, Roeland de Pottere was fiercely opposed to mixed marriages. P. Begheyn, S.J., 'Johannes Vermeer en de Jezuïeten te Delft', *Oud Holland*, 121, 1, (2008), 40-55, J.M. Montias, *Vermeer en zijn milieu*, de Prom, Baarn, 1993, p. 120. Also J. Moerman, 'Nr. 61, De Schuilkerk van Hodenpijl', *Historische Vereniging Schipluiden*, sept. 2004, (http://www.middendelfland.net/061hodenpijlschuilkerk)

55 G.J.M. Weber, *Johannes Vermeer: Faith, Light and Reflection*, nai010 Publishers, Rotterdam 2023.

56 X. van Eck, *Clandestine Splendor*: *Paintings for the Catholic Church in the Protestant Dutch Republic*, Waanders publishers, Zwolle, 2008

57 J.M. Muller, 'Jesuit Uses of Art in the Province of Flanders', J.W. O'Malley (ed.) *The Jesuits II*: *Cultures, Sciences, and the Arts, 1570-1773*, University of Toronto Press, 2005, pp. 113-156, (http://doi.org/10.3138/9781442681552-013). Also, A.K.L. Thijs, *Van Geuzenstad tot Katholiek Bolwerk*: *Antwerpen en de Contrareformatie*, maatschappelijke betekenis van de kerk in contrareformatorisch Antwerpen, Brepols, Turnhout 1990.

58 St. Ignatius of Loyola, *The Spiritual Exercises of St. Ignatius of Loyola*, E. Mullan, S.J. (transl.) P.J. Kenedy & Sons, New York, 1914. (Christian Classics Etheral Library, (exercises.pdf (ccel.org))

59 H. Lulofs, *Romae non sic*, PhD-thesis, Rijksuniversiteit Groningen, 2017

60 G. Schwartz, '332 Vermeer's blood-sopping saint', *Schwartzlist columns*, (332 Vermeer's blood-sopping saint – Gary Schwartz Art Historian). Also Weber, Faith, Light and Reflection, *op. cit.* (note 54), p. 70

61 H.G. Slager, 'Johannes Vermeer and Rhoon Castle', (2022), 1-20, esp. p. 8, and pp. 15-16. www.essentialvermeer.com/misc/Johannes-Vermeer-and-Rhoon-castle.pdf .

62 Weber, Faith, Light and Reflection, *op. cit.* (note 54), p. 67

63 Gramatke, 'The Jesuit contribution to written art technological sources in the 17th and 18th centuries', *Sources on Art Technology* (*op. cit*. note 13), 107-114., Also diverse authors in *Baroque Influencers: Jesuits, Rubens, and the Arts of Persuasion,* P. Delsaert and E. van Thielen (eds.), Hannibal Publishers, Bruges, (B), 2023. S.J. Moran, 'Bringing the Counter-Reformation home: the domestic use of artworks at the Antwerp Beguinage in the seventeenth century', *Simiolus*, (3) 38 (2016), 144-158. Also Muller, 'Jesuit Uses of Art' *op. cit.* (note 54), pp. 113-156. M.M. Mochizuki, *Jesuit Art*, Brill Publishers, Leiden 2021. Also Weber, Faith, Light and Reflection, *op. cit.* (note 54), pp. 50-57.

64 On some of these paintings also the actual spacings of the ceiling

beams in the rooms of Rhoon Castle, seem to conform.
The leaded glass 15-block window patterns are on: *Girl interrupted in her Music*, Frick Collection, New York; *The Glass of Wine*, SMPK, Gemäldegalerie, Berlin; *Girl with a Wine Glass*, Herzog Anton Ulrich Museum, Braunschweig; *The Music Lesson*, The Royal Collection, Windsor Castle; *Woman with a Lute*, Metropolitan Museum of Art, New York; *Young Woman with a Water Pitcher*, Metropolitan Museum of Art, New York; *Woman with a Pearl Necklace*, SMPK, Gemäldegalerie, Berlin; *Lady writing Letter with Maid*, National Gallery of Ireland, Dublin. The paintings with this window pattern are generally dated between 1658~~1665, with the Dublin painting even being dated as late as 1670-1671. This would indicate that Vermeer frequented Rhoon Castle also after the death of Isaac van de Mije in 1656. Slager, Vermeer and Rhoon Castle, *op.cit.* (note 60), p. 2. The heraldry of the 15-block motif is extensively discussed on pp. 2-6.

65 Liedtke even suggested that Vermeer might not have served any apprenticeship at all: W. Liedtke, M.C. Plomp, A Ruger, *Vermeer and the Delft School*, Metropolitan Museum of Art, New York, 2001, p. 15

66 Slager, Vermeer and Rhoon Castle, *op.cit.* (note 60), p. 8. J.W. Stokman, 'Pater Barten en zijn dienstverlening', *Afscheid van J.T.P. Barten S.J. als archivaris van de Nederlandse Provincie*, Nijmegen 1989, 4-9. Also Begeyn, Vermeer en de Jezuïeten te Delft, *op. cit.* (note 53) pp. 43, 49. Also Weber, Faith, Light and Reflection, *op. cit.* (note 54), p. 49-50. C. Parker, 'Uncovering the Jesuit influence on Vermeer, one of the Netherlands' greatest painters', *America, the Jesuit Review*, January 27, 2023. Also see Gramatke, (note 13).

67 Pigment identifcation with PLM (see note 21). This was confirmed on the basis of the identification of Fe and Mn (for hydrous iron oxides and umber) in the ochre yellow paint by x-ray fluorescence measurements (see note 22).

68 Wheelock, "St. Praxedis": the Earliest dated Painting by Vermeer', op. cit. (note 3), p.10, fig. 3.

69 Slager, Vermeer and Rhoon Castle, *op.cit.* (note 60), p. 16